WHAT IS CLAIMED IS:

1. A bulk, superhard, nanocomposite compact consisting essentially of nanocrystalline grains of at least one high-pressure phase of B-C-N surrounded by amorphous diamond-like carbon grain boundaries.

2. The compact of claim 1, wherein said compact has a Vickers hardness of about 41-68 GPa.

3. The compact of claim 1, wherein said compact has a Vickers hardness of about 50-68 GPa.

4. The compact of claim 1, wherein said compact has a Vickers hardness of about 62-68 GPa.

5. The compact of claim 1, wherein said compact has a Vickers hardness of 68 GPa.

6. A process for preparing a bulk, superhard, nanocomposite compact consisting essentially of nanocrystalline grains of at least one high-pressure phase of B-C-N surrounded by amorphous, diamond-like carbon grain boundaries, comprising the steps of:

(a) ball milling a mixture of graphite and hexagonal boron nitride to produce a mixture of amorphous and/or nanocrystalline graphitic carbon and boron nitride;

(b) encapsulating the ball-milled mixture; and

(c) sintering the encapsulated ball-milled mixture at a pressure of about 5-25 GPa and a temperature of about 1000-2500 K, thereby producing a bulk, superhard nanocomposite compact consisting essentially of nanocrystalline grains of B-C-N surrounded by amorphous diamond-like carbon grain boundaries.

7. The process of claim 6, wherein the ball milled mixture of graphite hexagonal boron nitride consists essentially of about 1-4 parts graphite to about 1 part hexagonal boron nitride.

8. The process of claim 7, wherein the ball milled mixture of graphite and hexagonal boron nitride consists essentially of about 1 part graphite to about 1 part hexagonal boron nitride.

9. The process of claim 7, wherein the ball milled mixture of graphite and hexagonal boron nitride consists essentially of about 2 parts graphite to about 1 part hexagonal boron nitride.

10. The process of claim 7, wherein the ball milled mixture of graphite and hexagonal boron nitride consists essentially of 4 parts graphite to about 1 part hexagonal boron nitride.

11. The process of claim 7, wherein the encapsulated ball-milled mixture is sintered at a pressure of about 10-25 GPa and at a temperature of about 2000-2500 K.

12. The process of claim 7, wherein the encapsulated ball-milled mixture is sintered at a pressure of about 15-25 GPa and at a temperature of about 2000-2500 K.

13. The process of claim 7, wherein the encapsulated ball-milled mixture is sintered at a pressure of about 16-25 GPa and at a temperature of about 2100-2500 K.

14. The process of claim 7, wherein the encapsulated ball-milled mixture is sintered at a pressure of about 20-25 GPa and at a temperature of about 2000-2500 GPa.

15. The process of claim 7, wherein the encapsulated ball-milled mixture is sintered at a pressure of about 20-25 GPa and at a temperature of about 2100-2400 K.

16. The process of claim 7, wherein the encapsulated ball-milled mixture is sintered at a pressure of about 20 GPa and at a temperature of about 2000-2400 K.

17. The process of claim 7, wherein the encapsulated ball-milled mixture is sintered at a pressure of about 25 GPa and at a temperature of about 2100-2300 K.

18. The process of claim 6, wherein step (b) comprises encapsulating the amorphous mixture in capsule comprising platinum, gold, rhenium, or boron nitride.

19. The process of claim 7, wherein said compact has a Vickers hardness of about 41-68 GPa.

20. The process of claim 7, wherein said compact has a Vickers hardness of about 50-68 GPa.

21. The process of claim 7, wherein said compact has a Vickers hardness of about 62-68 GPa.

22. The process of claim 7, wherein said compact has a Vickers hardness of 68 GPa.

23. A bulk, superhard, nanocomposite compact consisting essentially of nanocrystalline grains of at least one high-pressure phase of B-C-N surrounded by amorphous diamond-like carbon grain boundaries produced by the process comprising the steps of:

(a) ball milling a mixture of graphite and hexagonal boron nitride to produce a mixture of amorphous and/or nanocrystalline graphitic carbon and boron nitride;

(b) encapsulating the ball-milled mixture; and

(c) sintering the encapsulated ball-milled mixture at a pressure of about 5-25 GPa and a temperature of about 1000-2500 K, thereby producing a bulk, superhard nanocomposite compact consisting essentially of nanocrystalline grains of B-C-N surrounded by amorphous diamond-like carbon grain boundaries.

24. The compact of claim 23, wherein the ball milled mixture of graphite hexagonal boron nitride consists essentially of about 1-4 parts graphite to about 1 part hexagonal boron nitride.

25. The compact of claim 24, wherein the ball milled mixture of graphite and hexagonal boron nitride consists essentially of about 2 parts graphite to about 1 part hexagonal boron nitride.

26. The compact of claim 24, wherein the ball milled mixture of graphite and hexagonal boron nitride consists essentially of about 4 parts graphite to about 1 part hexagonal boron nitride.

27. The compact of claim 24, wherein the encapsulated ball-milled mixture is sintered at a pressure of about 10-25 GPa and at a temperature of about 2000-2500 K.

28. The compact of claim 24, wherein the encapsulated ball-milled mixture is sintered at a pressure of about 15-25 GPa and at a temperature of about 2000-2500 K.

29. The compact of claim 24, wherein the encapsulated ball-milled mixture is sintered at a pressure of about 16-25 GPa and at a temperature of about 2100-2500 K.

30. The compact of claim 24, wherein the encapsulated ball-milled mixture is sintered at a pressure of about 20-25 GPa and at a temperature of about 2000-2500 GPa.

31. The compact of claim 24, wherein the encapsulated ball-milled mixture is sintered at a pressure of about 20-25 GPa and at a temperature of about 2100-2400 K.

32. The compact of claim 24, wherein the encapsulated ball-milled mixture is sintered at a pressure of about 20 GPa and at a temperature of about 2000-2400 K.

33. The compact of claim 24, wherein the encapsulated ball-milled mixture is sintered at a pressure of about 25 GPa and at a temperature of about 2100-2300 K.

34. The process of claim 24, wherein said compact has a Vickers hardness of about 41-68 GPa.

35. The process of claim 24, wherein said compact has a Vickers hardness of about 50-68 GPa.

36. The process of claim 24, wherein said compact has a Vickers hardness of about 62-68 GPa.

37. The process of claim 24, wherein said compact has a Vickers hardness of 68 GPa.

38. The bulk, superhard, nanocomposite compact of claim 23, wherein step (b) comprises encapsulating the ball-milled mixture in capsule comprising platinum, gold, rhenium, or boron nitride.

39. A machining tool comprising a bulk, superhard, nanocomposite compact consisting essentially nanocrystalline grains of B-C-N surrounded by amorphous diamond-like carbon grain boundaries.

40. The tool of claim 39, wherein said compact has a Vickers hardness of about 41-68 GPa.

41. The tool of claim 39, wherein said compact has a Vickers hardness of about 50-68 GPa.

42. The tool of claim 39, wherein said compact has a Vickers hardness of about 62-68 GPa.

43. The tool of claim 39, wherein said compact has a Vickers hardness of 68 GPa.